INVENTORY OF URBAN TREES TOWARDS SUSTAINABLE MANAGEMENT IN BENIN METROPOLIS, NIGERIA

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Abstract

Trees in urban areas have been recognized by some experts as highly beneficial to the urban populace is fast gaining prominence in developing countries. Assessing the composition such as species population and diversity can contribute to sustainable management. However, accurate and current information on urban trees which are planning and monitoring tools, are either not available or the available ones are out dated. To fill this gap, this study used a vegetation-community framework to document current information on the urban trees and the perceived benefits residents associate with urban trees in Benin metropolis, Nigeria. A total of 2 489 trees were enumerated. The minimum diversity criteria were met on analysis of the diversity of this population. The most common species recording high relative density were Dacryodis edulis (8.76%), Elaeis guineensis (6.03%), Mangifera indica (5.22%), Anarcardium occidentale (4.22%), Cocos nucifera (4.21%) and Terminalia catappa (4.02%). Notably, residents attitude towards urban trees were positive. This was driven by the ecosystem services such as climate modification, scenic appeal and flood and erosion control people associate with urban trees. There is dire need for regular monitoring of urban areas to provide current data for urban managers towards promoting sustainable development of trees in metropolitan areas.

***Keywords*:** Associated tree species, ecosystem services, vegetation-community framework

Introduction

Urban trees in and near cities have been recognized by some experts as highly beneficial to the urban populace. Urban trees referred to as woody vegetation within the environment of populated places, includes all trees owned by public and private entities living in urbanized societies(Baur et al., 2016; Nowak2014).The total canopy cover of urban trees consist of several stands of different species found on both public spaces, private areas, other free zones and living environment (Wolf and Kruger 2010). Notably, urban trees provide numerous ecosystem values categorized as cultural, provisioning, and supporting services. Most importantly, urban trees provide regulating and/or environmental services such as pollution reduction by improving air and water quality, waste decomposition and detoxification, lowering noise impacts and providing aesthetic environment in metropolitan areas (MEA 2015; Escobedo et al., 2011). Additionally, urban trees provide cooler air temperatures, intercept rainfall thereby reducing the risk of flooding and erosion, serve as wind break and sequester carbon in metropolitan centers (Arabomen et al., 2016;2019; Nowak 2014). Therefore, the enhancement and sustainable development of urban trees will contribute to strengthening measures for its preservation; curtail indiscriminate removal of urban tree species; and promote the transformation of the urban forestry sector to a better management of forest and trees in the context of environmental sustainability.

However, trends of urban tree destruction have been recorded in some major metropolitan areas of Nigeria (Ajewole 2001; Oguntala 1993). Ajewole (2001), stated that destruction of trees is usually caused by urbanization that involves interplay of several factors such as industrial expansion, construction activities, population growth and increasing demands for fire wood. Urbanization leads to the clearing of green spaces for the development and construction of roads, housing and other infrastructural facilities. This was affirmed by Popoola (2005), who stated that urbanization has been the main cause for the destruction and removal of urban trees in some major cities of Nigeria. In a related study, Huang (2014), reported that rapid economic development and sprawl of residents in cities of China has led to undue land changes and decline of the natural environment. In Nigeria, towns and cities are growing rapidly, however, according to Oguntala (1993), this rapid growth rate does not compliment the proportion at which the services are preserved. This is because trees are being cleared and/or removed for developmental purposes and in some cases, for its timber component. Consequently, urbanization makes the environment prone to conditions such as soil and water erosion, flooding, earth warming, ozone depletion among others, with significant effects on the quality of life of the urban residents.

Bassuk et al. (2009) affirmed that high diversity of tree species population is important to promote healthy urban environment. This is vital for cities that are rapidly growing especially in Nigeria. In addition, research and enumeration of urban tree benefits can create and promote public awareness as well as provide a basis for management of such services. Baur et al. (2016) suggested that public perceptions will influence how residents' think and interact with trees in urban communities. The contribution of public participation for sustainable development of the urban trees is a mechanism towards ensuring safe, resilient and sustainable cities (FAO 2004). Urban trees will contribute to increased resource efficiency, mitigation and adaptation to climate change process, disaster risk reduction and providing a global access to safe, green urban areas by 2030 (SDG 11). This can be achieved through a better understanding of their functions, management and how the people relate with the trees in urban society (FAO 2004). This study provides a basic way to understand the composition of urban trees in rapidly developing countries, using Benin metropolis, Nigeria as a case study. The vegetation-community framework (modified from Clark et al., 1998) adopted for this study operates on the premise that sustainable management of urban trees is a function and interaction of the vegetation resource and community approach (see Figure 1).

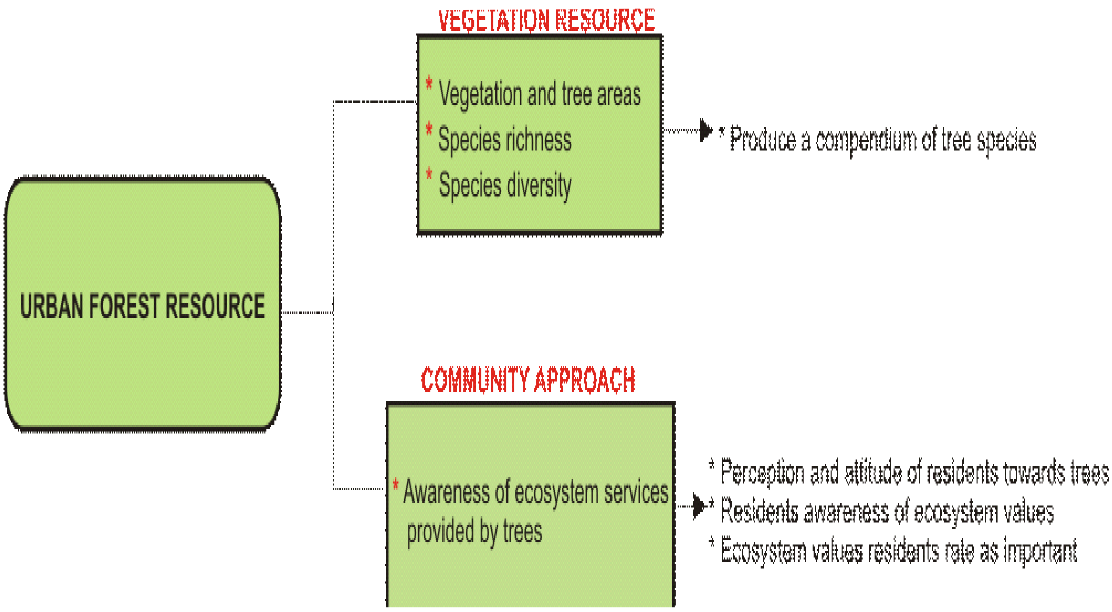

FIGURE 1 Operationalization of vegetation -community framework in relation to study objectives

Connecting the biophysical and socio-economic components can assist in developing appropriate management initiatives to protect trees in urban areas. Therefore, the study aim to: (i) assess the abundance and diversity of tree species (ii) investigate the ecosystem services and/or benefits residents associate with urban trees. Findings from this seminal study could assist in developing an assessment tool that could enhance adequate monitoring and future management plans for the urban trees in Benin Metropolis.

Methods

Study Area

Benin metropolis, in the Southern region of Nigeria, is the 4th largest metropolitan area in the country with an estimated 1 495 800 inhabitants in a land area of 1 204km² (NPC 2016). Administratively, there are 3 Local Government Areas (LGAs) and 39 districts (Egor- 10, Ikpoba-Okha- 11, Oredo- 18). The geographical coordinate is located at approximately Latitudes 6°10' and 6°30'N and Longitude 5°30' and 5°45'E. The average daily temperature is about 25°C. The metropolis has two seasons: a rainy period from March to October and a dry (harmattan) season from November to February (Eseigbe and Ojeifo 2007). The predominant vegetation is the moist deciduous forest that is composed of indigenous and exotic trees consisting of diverse and rich flora in areas such as botanical gardens, streets or avenues, public open spaces, roadsides, institutions and residences (Eseigbe and Ojeifo 2007).The boundary for this study was extracted from Google Earth satellite imagery of Benin metropolis for 2016(Aladesanmi et al.,2017; Balogun and Onokerhoraye 2017; Nowak 2014) (see Figure 2).

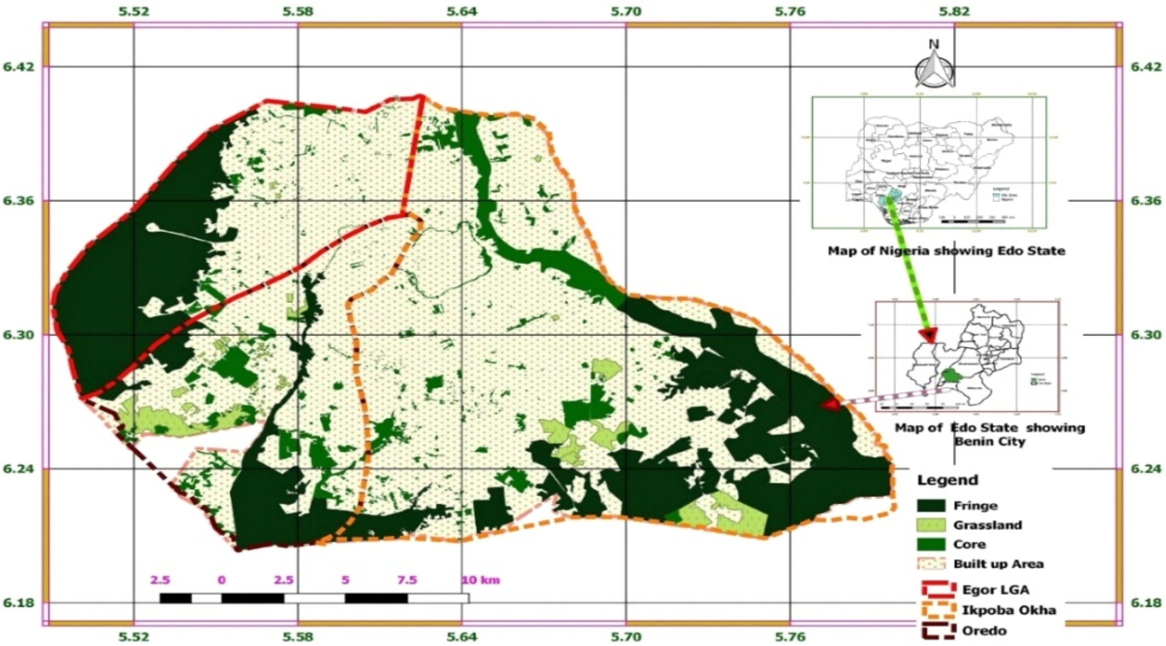

FIGURE 2Schematic of Benin metropolis showing the Local Government Areas

Tree survey and analysis
Requisite data was obtained in twenty-seven (27) randomly selected sites, representing 70% of the total number of districts and nine (9) in each Local Government Area (LGA) in Benin metropolis (see Figure 3). The survey was conducted between June and November 2017.

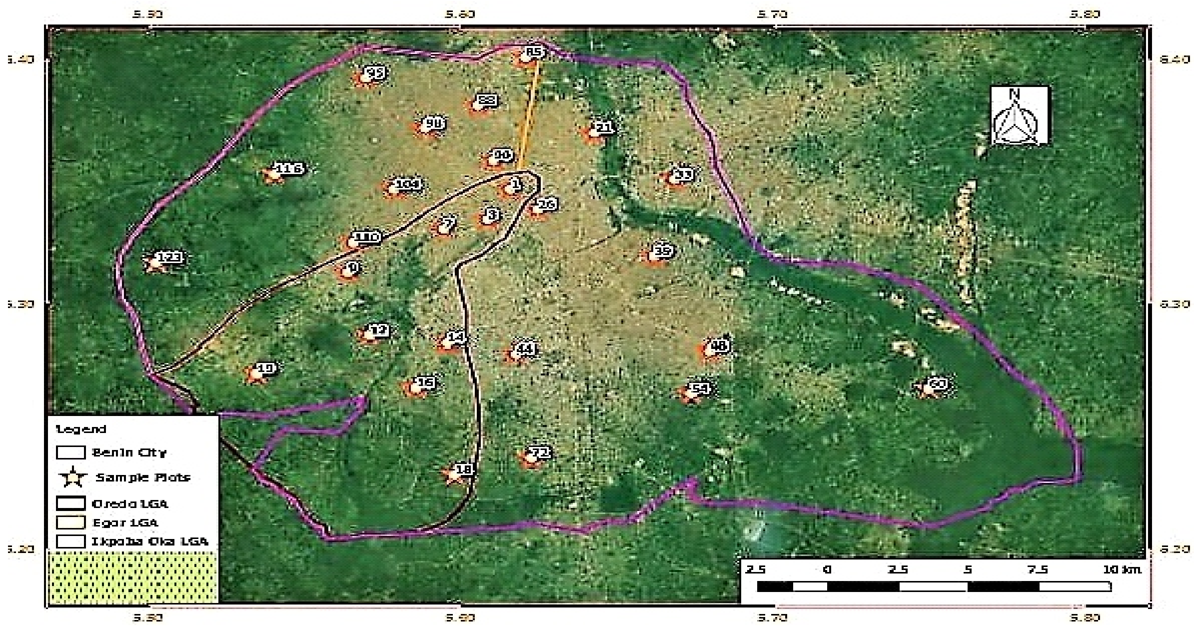

FIGURE 3 Selected sample plots in core and fringe areas of Benin metropolis

A standard transect line method was adopted for identification of tree species in the area (Aladesanmi et al., 2017; Uka and Belford 2016; Nowak et al., 2014; FAO 2011). The transect line of 100m was made using a nylon rope marked and numbered at 5m intervals; then all trees with diameter at breast height ⩾ 10 cm and within birds' eye view located on either side of the transect were identified to species level using the taxonomic keys of Flora of West Tropical Africa (Hutchinson and Dalziel 1972). The number of same tree species per site were obtained from the total number of the entire tree species recorded in the 2 x 100m transect line. In total, 27km^2 were surveyed, i.e. about 5% of the total urban area coverage (2018) in Benin metropolis. Ecological indices such as nomenclature, families, species richness, relative abundance, diversity index and evenness were computed for the surveyed trees.

Computational Procedures

Relative Density (RD): an index to assess species relative distribution was computed with:

$$RD = \left(\frac{ni}{N}\right) x100 \qquad (i)$$

Where RD (%) = species relative density;

n = the numberof trees of a given specie

and N is the total number of trees in the entire area.

Diversity index was computed using Shannon-Wiener diversity index equation

$$H^i = -\sum(p * \ln p) \qquad (ii)$$

Where H^i = Shannon -wiener index; $p_i = f/\sum f$

f= species frequency; $\sum$= summatio n); and

$\ln$ = the natural logarithm.

Shannon's maximum diversityindex

was calculated using: $H_{max} = \ln(S)$ (iii)

Where H_{max} = Shannon's maximum diversity index; and

S= the total number of trees; $\ln$ = the natural logarithm.

Species evenness in each stratum was determined using Shannon's equitability: $E_H = \left(\frac{H^i}{H_{max}}\right)$ (iv)

E_H= Species evenness; H^i= Shannon-wiener index;

H_{max}= Shannon's maximum diversity index

Socioeconomic Survey and Analysis

Reconnaissance survey and pre-test of 10% of the total number of the questionnaire were done to ensure validity and reliability. The sample included 350 residents who completed the self-administered questionnaires, such that respondents were requested to complete and return the questionnaire immediately. The respondents were selected randomly without considering any specific characteristic(Aladesanmi et al.,2017; Agbelade et al., 2016). The first part consisted of questions relating to (a) the cognition of respondents on urban trees (b) perceived ecosystem benefits residents associate with trees. In this first part, the ecosystem services (ES) were rated on a Likert-point scale of 1 (Unimportant) to 3 (Very important). This 3-point scale was necessary owing to the relatively low frequencies for certain ES. The second part of the survey obtained information about socioeconomic data of the respondents. Thus, seven (7) socioeconomic variables (gender, marital status, years of residency, education, employment, household size, income) were included to describe respondents from the sample in the study area.325 valid questionnaires were coded for the analysis. Egor, Oredo and Ikpoba-Okha respectively had a response rate of 94%, 93% and 91%. Descriptive statistics i.e. frequencies were used on categorical variables and summary statistics were done on continuous variables to describe the perception of respondents on trees and awareness of ES. Additionally, a mean rating was calculated for the ES. The means were separated at 95% confidence interval, to compare their importance. The means were then arranged in order of magnitude to determine the rankings.

Results

Tree Survey

The ecological indices for the tree species in Benin metropolis is presented in table 1. A cumulative of 2 489 trees were surveyed in the Metropolis. In addition, 96 tree species belonging to 39 families were recorded for the area. The families that recorded the highest number of trees included Euphorbiaceae, **Moraceae,** Fabaceae, Apocynaceae, Anarcardiaceae and Mimosaceae. The Shannon-Wiener diversity index ($H^i = 4.15$), Shannon's equitability index ($E_H = 0.91$) were recorded for motropils.

TABLE 1Summary result of tree ecological indices in Benin Metropolis

Parameter	
Number of tree species	2 489
Number of families	39
Species richness	96
Diversity index ($\mathbf{H^{i}}$)	4.15
Maximum diversity index ($\mathbf{H_{max}}$)	4.58
Species evenness ($\mathbf{E_{H}}$)	0.91

Notably, majority of the tree population were native species with relatively few exotic trees in the Metropolis. *Dacryodis edulis* in Burseraceae family had the *highest number of trees (218) per hectare. This was followed by Elaeis guineensis and Mangifera indica with 150 and 130 trees per hectare respectively.* Relative density varied from 0.04% to 8.76%. *Anacardium occidentale had the highest number of trees per hectare (86)* in the core areas. *Cocos nucifera*and *Terminalia catappa recorded the second highest number (67) of trees per hectare. Relative density ranged from 0.12% to 10.4%. Dacryodis edulis* (8.76%), *Elaeis guineensis (6.03%), Mangifera indica* (5.22%), *Anarcardium occidentale*(4.22%), *Cocos nucifera* (4.21%) and *Terminalia catappa* (4.02%) had the highest relative density in the area. Additionally, endangered species such as *Albiziasp.*, *Anthocleista sp.*, *Gossweilerodendron sp.*, *Terminalia sp.*, and *Nauclea sp.*, were identified in the Metropolis (see Table 2).

Table 2 Identified Tree Species in Benin Metropolis

Species	Family	Common name	No./ha	RD.(%)	P*LNP
Albizia ferruginea	Mimosaceae	Walnut tree	2	0.08	0.01
Albizia sassa	Mimosaceae	Walnut tree	1	0.04	0.003
Albizia sp	Mimosaceae	African walnut	8	0.32	0.02
Albizia zygia	Mimosaceae	-	43	1.73	0.07
Alchornea cordifolia	Euphorbiaceae	-	74	2.97	0.11
Alchornea laxiflora	Euphorbiaceae	-	30	1.21	0.05
Allanblanckia floribunda	Guttiferae	-	5	0.20	0.01
Allophylus africanus	Sapindaceae	-	48	1.93	0.08
Alstonia boonei	Apocynaceae	-	42	1.69	0.07
Anacardium occidentale	Anacardiaceae	Cashew tree	105	4.22	0.13
Annona muricata	Annonaceae	Sour sop	21	0.84	0.04
Anthocleista djalonensis	Loganiaceae	-	4	0.16	0.01
Azadirachta indica	Meliaceae	Neem tree	11	0.44	0.02
Bombax sp.	Bombacaceae	-	5	0.20	0.01
Bridelia micrantha	Euphorbiaceae	-	9	0.36	0.02
Cajanus cajan	Papilionaceae	-	20	0.80	0.04
Caliandra haematocephala	Fabaceae	-	10	0.40	0.02
Ceiba petandra	Bombacaceae	-	4	0.16	0.01
Chromolaena odorata	Asteraceae	Christmas bush	3	0.12	0.01
Chrysophyllum albidum	Sapotaceae	Cherry	3	0.12	0.01
Citrus aurantifolia	Rutaceae	-	6	0.24	0.02
Citrus sinensis	Rutaceae	orange	39	1.57	0.07
Cnestis ferruginea	Connaraceae	-	22	0.88	0.04
Cocos nucifera	Palmae	Coconut tree	105	4.21	0.13
Croton lobatus	Euphorbiaceae	-	10	0.40	0.02
Croton sp	Euphorbiaceae	-	6	0.24	0.02
Croton zambesicus	Euphorbiaceae	-	4	0.16	0.01
Cyathula prostrata	Amaranthaceae	-	15	0.60	0.03
Cycas revoluta	Cycadaceae	Palm tree	5	0.20	0.01
Dacryodis edulis	Burseraceae	Pear tree	218	8.76	0.21
Daniellia ogea	Caesalpiniaceae	Gum tree	6	0.24	0.02
Delonix regia	Caesalpiniaceae	Flamboyant tree	48	1.93	0.08
Dennettia tripetala	Annonaceae	Pepper fruit	2	0.08	0.01
Dialium guineense	Fabaceae	Velvet tamarind	5	0.20	0.01
Elaeis guineensis	Palmae	Oil palm tree	150	6.03	0.17

Euphorbia dendroides	Euphorbiaceae	-	1	0.04	0.00
Ficus axasperata	Moraceae	Ficus	91	3.66	0.12
Ficus benjamina	Moraceae	Ficus	11	0.44	0.02
Ficus capensis	Moraceae	Ficus	48	1.93	0.08
Ficus exasperate	Moraceae	Ficus	18	0.72	0.04
Ficus mucuso	Moraceae	Ficus	2	0.08	0.01
Ficus polita	Moraceae	Ficus	1	0.04	0.00
Ficus sp	Moraceae	Ficus	7	0.28	0.02
Ficus thonningii	Moraceae	Ficus	7	0.28	0.02
Gliricidia sepium	Fabaceae	-	9	0.36	0.02
Glyphaea brevis	Tiliaceae	-	4	0.16	0.01
Gmelina arborea	Verbenaceae	Melina	21	0.84	0.04
Gomphrena globosa	Amaranthaceae	-	10	0.40	0.02
Greenwayerodendron suaveolens	Annonaceae	-	17	0.68	0.03
Hevea brasiliensis	Euphorbiaceae	Rubber tree	20	0.80	0.04
Holarrhena floribunda	Apocynaceae	-	2	0.08	0.01
Hura creptans	Euphorbiaceae	Para rubber tree	4	0.16	0.01
Icacina trichantha	Icacinaceae	-	10	0.40	0.02
Irvingia gabonensis	Irvingiaceae	Ogbono	15	0.60	0.03
Khaya senegalensis	Meliaceae	-	6	0.24	0.01
Lecaniodiscus cupanioides	Sapindaceae	-	7	0.28	0.02
Lonchocarpus cyanescens	Papilionaceae	-	21	0.84	0.04
Mangifera indica	Anacardiaceae	Mango	130	5.22	0.15
Microdesmis puberula	Euphorbiaceae	**-**	**3**	**0.12**	**0.01**
Milicia excelsa	Moraceae	Iroko tree	14	0.56	0.03
Morinda lucida	Rubiaceae	-	10	0.40	0.02
Moringa oleifera	Moringaceae	Moringa	26	1.04	0.05
Morus mesozygia	Moraceae	Mulberry	1	0.04	0.00
Musanga cecropioides	Moraceae	-	4	0.16	0.01
Nauclea latifolia	Rubiaceae	-	4	0.16	0.01
Newbouldia laevis	Bignoniaceae	-	81	3.25	0.12
Peltophorum pterocarpum	Caesalpiniaceae	-	34	1.37	0.06
Pentaclethra macrophylla	Mimosaceae	-	11	0.44	0.02
Persea americana	Lauraceae	-	70	2.81	0.10
Phyllantus discoideus	Euphorbiaceae	-	11	0.44	0.02
Phyllantus mannianus	Euphorbiaceae	-	14	0.56	0.03
Pinus caribaea	Pinaceae	Pine tree	14	0.56	0.03
Plumeria rubra	Apocynaceae	Pigeon tree	14	0.56	0.03
Polyalthia longifolia	Annonaceae	Masquerade tree	77	3.09	0.10
Psidium guajava	Myrtaceae	Guava tree	74	2.98	0.11
Rauvolfia vomitoria	Apocynaceae	-	41	1.65	0.07
Ricinodendron heudelotii	Euphorbiaceae	-	6	0.24	0.02
Roystonea regia	Arecaceae	Roya palm tree	67	2.69	0.10
Senna alata	Fabaceae	Candle tree	14	0.56	0.03
Senna fistula	Fabaceae	Raintree	7	0.28	0.02
Senna occidentalis	Fabaceae	Coffee weed	4	0.16	0.01
Senna siamea	Fabaceae	-	33	1.33	0.06
Shurea spp	Dipterocarpaceae	-	3	0.12	0.01
Solanum sp	Solanaceae	-	8	0.32	0.02
Spatodia sp	Bignoniaceae	Tulip tree	5	0.20	0.01
Spondias mombin	Anacardiaceae	Plum tree	18	0.72	0.04
Sterculia tragacantha	Sterculiaceae	-	14	0.56	0.29
Tectona grandis	Verbenaceae	Teak	45	1.81	0.07
Terminal ia catappa	Combretaceae	Almond tree	100	4.02	0.13
Terminalia mentalis	Combretaceae	Almond tree	68	2.73	0.10
Theobroma cacao	Sterculiaceae	Cocoa tree	13	0.52	0.03
Thevetia neriifolia	Apocynaceae	-	9	0.36	0.02
Treculia africana	Moraceae	-	7	0.28	0.02
Trema orientalis	Ulmaceae	-	8	0.32	0.02
Voacanga africana	Apocynaceae	-	6	0.24	0.02

Socioeconomic Survey

Demographic Profile of the Respondents

The result of the demographic profile showed that except in Oredo, men (57% - 64%) were the majority of the sampled respondents across the LGAs (Table 3). There were mostly married people who have spent a minimum of 21 and maximum of 40 years across the municipalities. Only few (8%-11%) respondents had no formal education in Oredo, Egor and Ikpoba-Okha. Additionally, 59%, 84% and 63% of the residents in Egor, Ikpoba-Okha and Oredo respectively earned N51 000 (US$140) or more monthly (Table 3).

Table 3: Demographic Description of the Respondents

	Proportion of respondents (%) in		
Socioeconomic measure††	**Egor (n = 102)**	**Ikpoba-Okha (n = 106)**	**Oredo (n = 116)**
Gender			
Female	36.3	43.4	54.0
Male	63.7	56.6	46.2
Marital status			
Married	60.8	67.9	68.4
single	39.2	32.1	31.6
Education attained			
Postgrad	27.5	24.5	23.1
Undergrad	31.4	21.7	37.6
College	30.4	42.5	30.8
None	10.8	11.3	8.50
Years of residency			
⩽ 10	14.7	2.80	1.70
11-20	23.5	27.4	20.1
21-30	33.3	34.0	35.0
31-40	28.4	35.8	43.6
Income level			
Low - ⩽₦50 000	40.2	15.1	36.8
Middle - ₦51- 100 000	32.4	49.1	41.9
High - ⩾₦101 000	27.5	35.8	21.4

†† Rounding may result in numbers not adding to 100%

$US1 = ₦365

Perception of Respondents on Urban Trees

Overall, most residents (79%) in Egor, Oredo and Ikpoba-Okha LGAs had a positive appreciation for trees in the improvement of quality of life in the urban environment. This was in relation to the ecosystem services (ES) people associate with urban trees. Most residents(80%, n = 261), irrespective of their demographic profile in the core and fringe of the LGAs were aware that trees provide ES in urban areas, as opposed to the 20% (n = 64) who were not aware. In Table 4, people who had no knowledge of ES were in decreasing order more in Egor (22%) followed by Ikpoba-Okha (20%) and Oredo (17%). Most of these were also living in core areas (20%). In this study, **t**hose without prior knowledge of ES had no formal education (33%). Additionally, those without prior knowledge of ES would have lived in the city for less than 10 years (34%) with an average income of N74 000 (US$200).

TABLE 4 Demographic profile of respondents based on knowledge of ecosystem serv ices

Socioeconomic measure[††]	Knowledge of Ecosystem Services Number (n = 261)	%	No Knowledge of Ecosystem Services Number (n = 64)	%
LGAs				
Egor	80	78.4	22	21.5
Ikpoba-Okha	84	79.3	22	20.8
Oredo	97	82.9	20	17.1
Residential Location				
Core	156	80.0	39	20.0
Fringe	105	80.8	25	19.2
Gender				
Female	114	79.2	30	20.8
Male	147	81.2	34	18.8
Type of Profession				
Paid jobs	91	79.8	23	20.2
Trading	103	76.9	31	23.1
Unemployed	67	87.0	10	12.9
Years of residency				
< 10	19	65.6	10	34.5
10-20	66	81.5	15	18.5
21-30	84	76.4	26	13.6
31-40	92	87.6	13	12.4
Educational attainment				
Graduate school	75	86.2	12	13.7
4-year degree	80	84.2	15	15.8
High school	84	76.4	26	23.6
None	22	66.7	11	33.3
Monthly income level (₦)				
Low - < 50 000	95	87.9	13	12.0
Middle - 50 000 - 100 000	93	72.7	35	27.3
High - > 100 000	73	82.0	16	17.9

[††] Rounding may result in numbers not adding to 100%

Furthermore, across the LGAs, the most frequently cited ES wereregulating services such as flood and erosion control (mean = 2.83 ± 0.04), provision of shade (mean = 2.74 ± 0.05), control of local temperature (mean = 2.33 ± 0.05) and provision of scenic beauty (mean = 2.42 ± 0.04). Snippets of provisioning and cultural services though cited, were considered least important(Figure4).

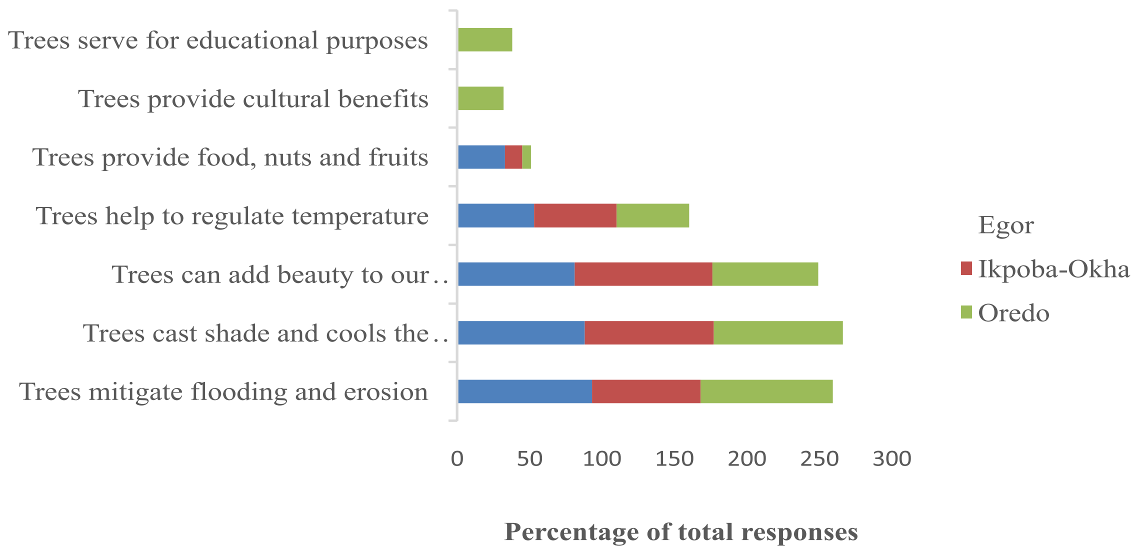

FIGURE 4 Ecosystem services derived from urban trees (Source: Field survey, 2017)

Discussion

Tree Vegetation Distribution

Urban trees form vital part of green infrastructure in cities that can play essential roles in urban ecosystems through the numerous services they provide (Sinclairet al., 2014). In this study, more than half of the sampled tree species were indigenous, with few exotic trees in Benin Metropolis. These native trees were existing in the area prior to development, while the exotic trees were either planted or introduced by other means. This finding contradicts previous studies in other developing countries like Ghana, Eastern Cape of South Africa and Bangalore, India where exotic and alien species have been reported to constitute a greater proportion of trees in the urban landscapes (Nagendra and Gopal 2010). Kuhns (2009) reiterates that indigenous trees can advance biodiversity and creation of wildlife corridors while stimulating a feeling of spot for connection to nature (Wafa *et al*., 2017). Thus, the urban structure in Benin metropolis can serve as an in-situ conservation method to protect and conserve native tree species in Nigeria.

Additionally, findings from previous studies (Wafa et al., 2017) and this study show that Dacryodis edulis, Mangifera indica, Terminalia catappa, and Anarcadium occidentalis were utilized as urban trees in relatively more numbers in cities. Most of these indigenous species are existing prior to development or deliberately planted for the regulating and provisioning benefits as shade and fruits for the people. Moreover, similar tree species from this study have been identified in some natural forest ecosystems in Nigeria and other African countries in Aladesanmi et al., 2017; Onyekwelu 2013 and; Wafa *et al.*, 2017. Thus, it is evident that the urban trees can be both reservoirs and contributors to global biodiversity conservation. Furthermore, an evaluation of species diversity index (SDI) in the metropolis showed that the urban structure is diverse in nature, owing to its tree species richness and even distribution. This compares to other metropolitan areas of the world. Sreetheran et al.(2011) reported SDI of 3.0 in Kuala Lumpur. Sun (1992) reported a SDI of 3.5 for tree populations in USA cities and towns, while seven cities in United Kingdom recorded a SDI of 4.1.

Perception of Respondents on Urban Trees

Urban trees are important features in the environment that primarily provide services rather than goods (Nowak et al., 2010). These services are of both local and global importance. However, human actions directly or indirectly contribute to tree abundance in urban areas through their utility (Baur et al., 2016). In this study, the importance of the urban treesto mitigate flood and erosion ranked highest in the metropolis. Bolund and Hunhammar (2009) reiterated that preference for trees varies according to different environmental and socioeconomic condition of an area. For instance, the importance of trees in cushioning extreme events of flooding and erosion can be especially relevant in Benin metropolis, owing to rapid urban development (Balogun and Onokhoraye 2017; Eseigbe and Ojeifo 2007).

Another benefit people associated with trees was provision of shade and cooling of the urban environment. It was observed in this study, that people prefer to sit under the shade of tree canopies for their social gatherings, informal meetings, outdoor games and relaxation. This corroborates the findings of Lohr *et al.* (2004) who revealed that residents of the largest metropolitan areas in the United States considered trees important because they provide shade and cool their surroundings. Other regulating benefits such as regulation of local temperature and scenic beauty received positive rankings. Thus, Benin metropolis and many other major cities in Nigeria will need urban forestry professionals, community, government and other relevant stakeholders to deal with the challenges facing urban trees in providing liveable, sustainable and greener societies.

Conclusions

This study used a vegetation-community framework approach to provide current information on the abundance and diversity of trees and benefits residents associate with trees *in Benin Metropolis. Urban trees were a repository of indigenous and exotic species and the u*rban trees were rated important for the regulating services such as flood and erosion control, scenic beauty, temperature regulation and provision of shade in urban areas. It is important, therefore, to consider the values held by urban dwellers about urban trees**.** This could assist to improve and maintain the urban trees in metropolitan areas. Additionally, to ensure the availability of current and accurate data for urban managers towards sustainable development of urban trees, inventory and regular monitoring of urban areas is paramount.

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